

ART XVI.—*Notes on a Collection of Tertiary Fossils from
Ooldea and Watson, South Australia.*

BY

FREDERICK CHAPMAN, A.L.S.

Palaeontologist to the National Museum, Melbourne;
Hon. Palaeont. Geol. Surv. Vict.

(With Plates XVI., XVII. and Text Figure.)

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Introductory.

On account of the scarcity of information regarding fossils occurring in the area traversed by the construction of the Transcontinental Railway from Port Augusta to Kalgoorlie, it seems advisable to put on record some notes of the specimens now in the National Museum.

The fossils under consideration were collected by Messrs. F. A. Cudmore, R. C. Chandler and Dr. T. Griffith Taylor, B.E., B.A., F.G.S. Mr. Cudmore obtained a large collection of Miocene fossils, mainly as casts and moulds, in his recent trip to Ooldea and Watson, and a selection of these he has given to the Museum. I am also indebted to him for the photographs here reproduced, and for detailed information of the various fossiliferous exposures north and south of the railway.

Mr. R. C. Chandler was successful in obtaining a number of fossils in this locality during the early history of the line's construction, when engaged in acquiring natural history specimens for the Museum.

Dr. Griffith Taylor also collected a few fossils during his recent journey to Central South Australia, and has kindly donated the coral specimens—one of which is here figured—to the State collection.

Localities of Collection.

The Ooldea Soak¹ has been known to travellers from Fowler's Bay for many years. It is situated on the Nullaboor Plains, west of the sand-hill country, about 100 miles N.W. of Fowler's Bay, and about three miles north of the railway line. Various outcrops of

1. See S. A. White. *The Emu*, Jan. 1919, p. 189.

granite appear in this area, having a general north-westerly trend, and there are indications of the superimposed Tertiary beds having been displaced in that direction. This, indeed, may account for the occurrence of the Soak in this desert country, far away from any other visible water-hole, except some salt lakes, as Lake Tallacootra, to the south, and which are evidently due to a similar cause. It is just possible that sub-artesian water is tapped here, and remains held up by the heavier or impervious shell-marls of the Pleistocene deposit.

The collection made by Mr. Chandler comprises both Janjukian, or Miocene fossils (mainly as casts), and some Older Pleistocene material, cemented together or in loose specimens.

The small but interesting collection made by Dr. Griffith Taylor was from Janjukian beds. The specimens include a hard limestone with *Chlamys* cf. *murrayanus*, Tate sp., and two examples of a Janjukian coral, *Orbicella* (olim *Heliastrea*) *tasmaniensis*, Duncan sp., which had rarely before been found outside of Tasmania. This *Orbicella*, Mr. Cudmore informs me is abundantly scattered over various parts of the Plains.

The collection made by Mr. Cudmore comprises more than a hundred specimens. They are chiefly preserved in a hard ochreous and white limestone, generally as casts and moulds, although some still retain the shell structures, as *Chlamys murrayanus*. Mr. Cudmore's specimens came principally from the Ooldea Well (not used), 300 yards west and 200 yards south of Ooldea railway station, though a few of similar kinds were obtained from the half-mile cutting at Watson, next to Ooldea, on the road to West Australia. The limestone country is well shown by photographs here reproduced, taken by Mr. Cudmore.

On glancing at the geological map of this district, one sees that Ooldea is situated on the later Tertiary bed, but close to the boundary of outcrop of the Miocene series. From the disposition of the two Tertiary beds, as mapped, it would appear probable that the Pleistocene deposit represents a fairly shallow marine bed laid down upon, and flanking a Miocene limestone, which extended south-eastward as a promontory, as far as long. $133^{\circ}30'$ at the present time, as now seen exposed in the elevated plains. From the fact that the Ooldea Soak is fresh, it is highly probable that the water is deep-seated, and has its origin in or below the mass of Miocene limestone, which must here be faulted, as seems to be indicated by the sporadic but linear arrangement of inliers of deep-seated rocks, and is not an ordinary soak in an impervious

bed. In fact, this theory of the presence of faults along this particular trend line is supported by the parallel system of fractures re-entrant along the coast, stepped in the same direction from the Head of the Bight to Anxious Bay, and even beyond.

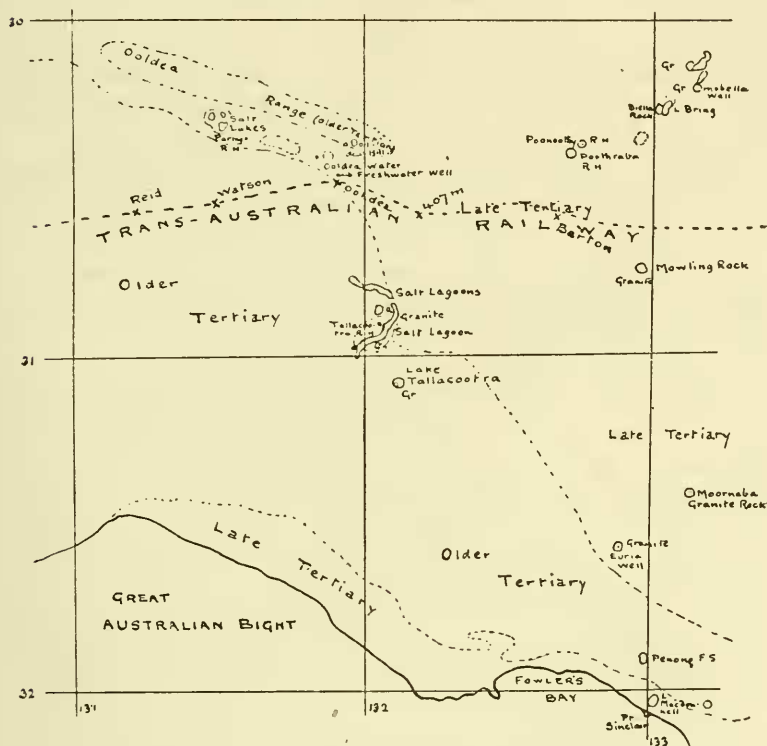


Fig. 1. Sketch Map of South Australian area including Fowler's Bay and the Ooldea Soak. Main details taken from the geological map of South Australia, by H. Y. L. Brown, 1899.

This shows the trend, in a north-westerly and south-easterly direction, of probable fracture zones, involving the Miocene and Pleistocene rocks. The direction of sand-ridges are also seen to be influenced by the underlying structure, since, as Mr. Henry Deane, M.A., informs me, they generally run in a similar way. These fracture lines would also appear to have a considerable bearing on the disposition of water holes, lagoons and soaks in this part of the country.

Areas in this map marked Granite may also include Metamorphic rocks, as Gneiss, Hornblende and Mica Schists; also Diabase dykes and mineral veins.

The Older Tertiary can be referred to the Miocene, to which the older fossiliferous beds of the Ooldea Soak belong.

The late Tertiary includes the Older Pleistocene of the Ooldea Soak and all subsequent stages, as Sand-dune rock and Concretionary limestone.

OLDER PLEISTOCENE FOSSILS FROM THE OOLDEA
DISTRICT.

Order FORAMINIFERA.

Genus *Orbitolites*, Lamarck.

Orbitolites complanata, Lamarck.

Orbitolites complanata, Lamarck, 1801, Syst. Anim. sans Vert., p. 376. Carpenter, 1856, Phil. Trans., p. 224, pls. IV-IX. Chapman, 1913, Proc. R. Soc. Viet., vol. XXVI. N.S. pt. I. p. 170.

This species ranges from the Balcombian (Muddy Creek), through Janjukian (Mallee Bores) to Werrikooian and Pleistocene (Well borings, Murray Flats, and Croydon Bore, near Adelaide).

A fine sample of limestone, largely composed of the above fossil, together with mollusca (*Clanculus* and *Brachyodontes*) was presented to the National Museum by Mr. R. H. Matthews, who obtained it from Yorke Peninsula, six miles N.W. of Yorketown.

O. complanata occurred in the Croydon Bore as far down as 450 feet, and was there associated with *Lagavum* and *Glycimeris*. At 395-415 feet the associated fauna was *Ostrea angasi*, *Glycimeris obliquus*, *G. convexus*, *Limopsis tenisoni* (recorded as *L. helcheri*), *Crassatellites oblonga*, *Mesalia provisi* and *Cassis fimbriatus*. This fauna contains some archaic forms, as *Mesalia provisi* and *Glycimeris convexus*, and the age of the deposit is certainly Werrikooian or Upper Pliocene. In the present sample, as in the raised beach at Yorke Peninsula, the beds are slightly younger, and may be referred to the older raised beach stage, or Lower Pleistocene.

Chandler Collection.

Class PELECYPODA.

Fam. ARCIDAE.

Genus *Arca*, Lamarck. Subgenus *Anadara*, Gray.

Arca (Anadara) trapezia, Deshayes.

Arca trapezia, Deshayes, 1840, Mag. Zool., p. 21, 3 figs.

The shell attains a large size in this bed, and vies with similar large specimens in the Pleistocene of the West Melbourne Swamp. They reach a length of 104 mm., and a height of 81 mm.; the shells are embedded in a fine calcareous mud. Although the abundance of this species might suggest estuarine influence, the remainder of the associated mollusca are of the ordinary open water type.

Chandler Collection.

Fam. PINNIDAE.

Genus *Pinna*, Linné.

Pinna intermis, Tate.

Pinna zeylanica, Angas (non Gray), 1865, Proc. Zool. Soc., p. 655.

Pinna inermis, Tate, 1886, Trans. R. Soc. S. Austr., vol. IX., p. 71, pl. IV., Fig. 5.

Prof. Tate records this species from St. Vincent's Gulf, and generally from Eucla to the south-east coast of South Australia. It is found "partially buried vertically in mud or sand in a few fathoms water."

In some respects the fossil shell resembles the earlier portion of *P. virgata*, Menke, a West Australian living form, but is distinguished by the feeble radial ridges, which in the living species are very distinct.

Chandler Collection.

Fam. PECTINIDAE.

Genus *Chlamys*, Bolten.

Chlamys bifrons, Lamarck, sp.

Pecten bifrons, Lamarck, 1819, Anim. sans. Vert., vol. VI. pt. II., p. 164, No. 4.

Chlamys bifrons, Hedley, 1914, Biol. Results Endeavour, vol. II., p. 73.

This species is recorded from the shores of New South Wales, Victoria and South Australia. The related form, *Chlamys undulatus*, Sow. sp., is noted as living in Western Australia. The fossil specimens are typical of *C. bifrons*.

Chandler Collection.

Fam. MYTILIDAE.

Genus *Brachyodontes*, Swainson.

Brachyodontes hirsutus, Lamarck, sp.

Mytilus hirsutus, Lamarck, 1818, Anim. sans. Vert., vol. VI. pt. I. p. 120, No. 5.

Brachyodontes hirsutus, Lam. sp., Hedley, 1917, Journ. R. Soc. New South Wales, vol. LI. Suppl. p. 11.

This species is abundant on the South Australian, Victorian and New South Wales coasts, but seems to be unrecorded from Western Australia.

Chandler Collection.

Fam. VENERIDAE.

Genus **Marcia**, H. and A. Adams. Subgenus **Katelysia**, Römer

Marcia (Katelysia) strigosa, Lamarck, sp.

Venus strigosa, Lamarck, 1818, Anim. sans Vert., vol. V., p. 605.

This common shell is found on muddy and sandy beaches at low tide.

Chandler Collection.

Class GASTEROPODA.

Fam. TROCHIDAE.

Genus **Clanculus**, Montfort.

Clanculus dunkeri, Koch sp.

Trochus dunkeri, Koch, 1843, in Philippi, Abbild. und Beschneuer Couch., vol. 1, pt. III. p. 67, pl. II. Fig. 5.

Clanculus dunkeri, Koch sp., Pritchard and Gatliff, 1902, Proc. R. Soc., Vict. vol. XIV. (N.S.), pt. II., p. 121.

This species is found living in South Australia and Western Australia, and is recorded from Westernport, Victoria.

Chandler Collection.

Fam. TURRITELLIDAE.

Genus **Turritella**, Lamarck.

Turritella clathrata, Kiener.

Turritella clathrata, Kiener, 1843, Icon. Coq. Viv., p. 33, pl. XIV., Fig. 1, Reeve, 1849, Conch. Icon., vol. V., pl. VIII., Fig. 37. Pritchard and Gatliff, 1900, Proc. R. Soc. Vict. vol. XII. (N.S.) pt. II., p. 202.

This is a well known South Australian species, and is also recorded from the south-west coast of Victoria.

Chandler Collection.

Fam. CERITHIIDAE.

Genus **Bittium**, Leach.

Bittium cerithium, Quoy and Gaimard sp.

Turritella cerithium, Quoy and Gaimard, 1834, Voyage Astrolabe, vol. III. p. 139, pl. LV. Figs. 27. 28.

A common form in Victorian waters; apparently absent from lists of other States.

Chandler Collection.

Fam. COLUMBELLIDAE.

Genus **Columbella**, Lamarck.

Columbella aff. semicouveza, Lamarck sp.

Buccinum semicouveza, Lamarck, 1822, Anim. sans Vert., vol. VII. p. 272.

Pyrene semicouveza, Lam. sp., Hedley, 1917, Journ. R. Soc. New South Wales, vol. LI. Supp. p. 90.

This is a common shell, frequent in most shallow sands round the Southern Australian coasts.

Chandler Collection.

Fam. FUSIDAE.

Genus **Fusus**, Lamarck.

Fusus australis, Quoy and Gaimard.

Fusus australis, Quoy and Gaimard, 1833, Voy. Astrolabe, vol. II. p. 495, pl. XXXIV. Figs. 9-14. Tryon, 1881, Man. Conch. vol. III., p. 55, pl. XXXIV., Figs. 113, 116, 118.

A common shore-living shell in South Australia and Victoria.

Chandler Collection.

Genus **Fasciolaria**, Lamarck.

Fasciolaria australasia, Perry sp.

Pyrgula australasia, Perry, 1811, Conchology, pl. LIV., Fig. 4.

Fasciolaria australasia, Perry sp., Hedley, 1903, Mem. Austr. Mus., vol. IV., p. 373.

A well-known south coastal species. Recorded from the Western Bight in 100 fathoms; the species also ranges to shallower depths.

Chandler Collection.

Fam. VOLUTIDAE.

Genus **Mitra**, Lamarck.

Mitra pica, Reeve.

Mitra pica, Reeve, 1845, Proc. Zool. Soc. Lond., p. 49, Idem, 1845, Conch. Icon., vol. II., pl. XXXI. Fig. 247. Pritchard and Gatliff, 1899, Proc. R. Soc. Vict., vol. XI. (N.S.) pt. II. p. 188.

This species is found living in South Australia, and it also occurs along the Victorian coast from Westernport to Warrnambool.

Chandler Collection.

Fam. BULLARIIDAE.

Genus **Bullaria**, Rafinesque.

Bullaria botanica (Hedley).

Bulla australis, Gray, 1825, Annals of Phil., N.S. vol. XXV. p. 408.

Bullaria botanica, Hedley, 1918, Journ. R. Soc. N. S. Wales, vol. LI. Suppl. p. 104 (nom. mut. for *B. australis*, Gray non Ferussac).

A well distributed species in littoral waters round the southern parts of Australia.

Chandler Collection.

MIOCENE FOSSILS FROM THE OOLDEA DISTRICT.

Order FORAMINIFERA.

Orbitolites complanata, Lamarck.

Genus **Orbitolites**, Lamarck.

This discoidal foraminifer, here also recorded from the Older Pleistocene (see antea page 228) reaches a diameter of $1\frac{1}{2}$ inches. The present occurrence of this large variety is interesting, since the older, Oligocene form in Australia is much smaller, and the younger, early and late Pleistocene, specimens are not quite so large. It is fairly common here.

Cudmore Collection.

Class ANTHOZOA.

Fam. TURBINOLIIDAE.

Genus **Placotrochus**, Edwards and Haime.

Placotrochus deltoideus, Duncan.

Placotrochus deltoideus, Duncan, 1864, Ann. and Mag. Nat. Hist. vol. XIV., p. 164, pl. V. Fig. 5.

Casts only. Cudmore Collection.

Fam. STYLOPHORIDAE.

Genus **Stylophora**, Schweigg.

Stylophora sp. nov.?

Numerous moulds and casts of a branching form. Cudmore Collection

Fam. ASTRAEIDAE.

Genus **Montlivaltia**, Lamaroux.cf. *Montlivaltia*, sp.

A species with a large discoidal, depressed calyx.
Cudmore Collection.

Genus **Orbicella**, Dana.

Orbicella tasmaniensis, Duncan sp. Plate I. Fig. 1.

Heliastrea tasmaniensis, Duncan, 1876, Quart. Journ. Geol. Soc. vol. XXXII. p. 342, pl. XXII., Figs. 1-3.

Astrangia tabulosa, Tate, 1893, Journ. R. Soc. N. S. Wales, vol. XXVII. p. 145, pl. XIII. Fig. 2.

Two species of the above named coral were presented by Dr. Griffith Taylor. They occur in the hard, reddish limestone of the Tertiary series, and were found on the surface of a salt lake east of Ooldea. One of them is preserved in hard, semi-crystalline limestone, in which the coral structure is much obscured; whilst the other is weathered and whitened, so that it has the appearance of a living coral. The structure of the weathered specimen is, however, none the less perfect, for this process has simply picked out the calcareous infilling. A large number of wind-worn pieces of this coral was also secured by Mr. Cudmore, who states that they occur scattered over the limestone plains. By their blackened and polished surfaces the fragments appear to have been exposed to the weather for a long time.

The species, living and fossil, formerly referred to the genus *Heliastrea*, are now relegated to *Orbicella* by Verrill and Quelch² by reason of priority.

There is a close agreement of these specimens from Ooldea with those from Tasmania, though the former have the calices rather larger in diameter (9:8). The weathered specimen shows that, although the dissepiments are, as a rule, curved downwards, this is by no means invariable. This specimen has the mesenteric pouches filled with a pale glauconite, thus showing, in common with other organic marine bodies, a tendency for the body cavity to act as a receptacle for the deposition of the hydrous silicate of iron, alumina and potash to form that mineral.

Orbicella tasmaniensis has, up to the present, been unknown from any locality outside Tasmania, excepting Flemington, Victoria. Taylor and Cudmore Collections.

2. Rep. Chall., Vol. XVI., Zool. 1886, p. 106.

Class ECHINOIDEA.

Fam. CLYPEASTRIDAE.

Genus *Laganum*, Gray.*Laganum* sp.

A fragmentary test shows a portion of the sub-angulately contoured ambitus and internal supporting pillars. The genus was previously recorded by Tate from the Tertiary of St. Vincent Gulf, South Australia. (*L. platymodes*.)

Cudmore Collection.

Class PELECYPODA.

Fam. PARALLELODONTIDAE.

Genus *Cucullaea*, Lamarek.*Cucullaea corioensis*, McCoy.

Cucullata corioensis, McCoy, 1876, Prod. Pal. Vict. Dec. III. p. 32, pl. XXVII. Figs. 3-5*b*. Tate, 1886, Trans. R.S.S. Austr., vol. VIII. p. 144. Harris, 1897, Cat. Tert. Moll. pt. I. Australasia. (Brit. Mus.) p. 336.

Numerous casts of this widely ranging species (Oligocene to Werrikooian), occur here.

Cudmore Collection.

Fam. ARCIDAE.

Genus *Glycimeris*, Da Costa.*Glycimeris maccoyi*, Johnston sp.

Pectunculus laticostatus, McCoy non Quoy and Gaimard, 1875, Prod. Pal. Vict. Dec. II. p. 26, pl. XIX. Figs. 10-14.

Pectunculus maccoyi, Johnson, 1884, Papers and Proc. R. Soc. Tas., p. 199, Id., 1888, Geol. Tas. p. 225, pl. XXX. Figs. 1. *Id.*

Casts and moulds of this common Tertiary species occur in the hard limestone.

Cudmore Collection.

Fam. PECTINIDAE.

Genus *Chlamys*, Bolten.*Chlamys murrayanus*, Tate sp.

Pecten murrayanus, Tate, 1886, Trans. Roy. Soc. S. Australia, vol. VIII., p. 105, Pl. VII., Figs. 5, *a*, *b*.

One of the specimens found four miles west of Ooldea by Dr. Griffith Taylor, is a cast in hard cream coloured limestone. Others collected from near the same locality (Watson cutting), by Mr. Cudmore, show a denuded shell, the riblets being devoid of ornament except in one case, where the structure is seen to be that of *C. murrayanus*; the appearance is misleading, and the shell might easily be mistaken for one of the Amusium type, like *A. yahliensis*, T. Woods sp.

In the Miocene seas *C. murrayanus* attained a large size, some examples measuring as much as $3\frac{1}{2}$ inches in length.

Previously recorded from South Australia in Miocene beds of the Lower Murray River.

Taylor, Chandler and Cudmore Collections.

Chlamys aldingensis, Tate sp.

Pecten aldingensis, Tate, 1886, Trans. R.S.S. Austr., vol. VIII., p. 109, pl. VII., Figs. 1a-c. Chapman, 1912, Mem. Nat. Mus. Melbourne, No. 4, p. 48.

Previously recorded from South Australia in the Miocene glauconitic limestone of Aldinga Bay. Dennant notes it from Stansbury, South Australia, and the present writer from the polyzoal limestone of Seal River, King Island. Cudmore Collection.

Fam. SPONDYLIDAE.

Genus *Spondylus*, Linné.

Spondylus cf. *gaderopoides*, McCoy.

Spondylus gaderopoides, McCoy, 1876, Prod. Pal. Vict., Dec. IV. p. 27, pl. XXXVIII. Figs. 1-1d.

Spondylus gaderopoides, McCoy, Tate, 1886, Trans. R. Soc. S. Austr., vol. VIII. p. 121.

Two casts of united valves occur here. They are solidly built, and of the general form of the above species, which, by the way, is a restricted Miocene fossil. Cudmore Collection.

Fam. LIMIDAE.

Genus *Lima*, Bruguière. Subgenus *Limatula*, Wood.

Lima (Limatula) jeffreysiana, Tate.

Lima (Limatula) jeffreysiana, Tate, 1886, Trans. R.S.S. Austr. vol. VIII. p. 119, pl. IV., Fig. 8.

A well preserved shell is found here. Cudmore Collection.

Fam. CRASSATELLITIDAE.

Genus **Crassatellites**, Kruger.*Crassatellites* cf. *oblonga*, T. Woods sp.*Crassatella oblonga*, T. Woods, 1875, Papers and Proc. R. Soc. Tasmania (1876), p. 25, pl. II., Fig. 11.

This internal cast closely resembles the Table Cape form specified above, especially in the anterior position of the umbones.

Cudmore Collection.

Fam. CARDITIDAE.

Genus **Cardita**, Bruguière.*Cardita* cf. *tasmanica*. Tate.*Cardita tasmanica*, Tate, 1886, Trans. R. Soc. South Austr. vol. VIII. p. 154, pl. XII. Fig. 13.

The species appears to be represented here by an internal cast, judging by the shape and number of riblets, with impressions of some still preserved, it is in all probability referable to the above

Cudmore Collection.

Cardita scabrosa, Tate.*Cardita scabrosa*, Tate, 1886, Trans. R. Soc. South Australia, vol. VIII., p. 152, pl. II., Fig. 4.

A good internal mould of this species occurs here.

Cudmore Collection.

Fam. LUCINIDAE.

Genus **Lucina**, Bruguière.*Lucina planatella*, Tate, 1886, Trans. R. Soc. S. Austr., vol. VIII., pl. XII. Fig. 11, Idem, 1887, *ibid*, vol. IX. p. 146.

Both moulds and casts, showing ornament and internal form are found in some frequency. The species was originally described as a Table Cape fossil. I have since identified it amongst fossils from Maude.

Cudmore Collection.

Fam. CARDIIDAE.

Genus **Cardium** Linné.*Cardium victoriae*, Tate.*Cardium victoriae*, Tate, 1887, Trans. R. Soc. S. Austr. vol. IX. p. 151, pl. XIV. Figs. 1a, b. Harris, 1897, Cat. Tert. Moll. Australasia (Brit. Mus.), p. 367.

Several examples showing typical surface ornament are found here.

Cudmore Collection.

Subgenus **Protocardium**, Beyrich.

Cardium (Protocardium) antisemigranulatum, McCoy.

Cardium (Protocardium) antisemigranulatum, McCoy, 1877, Prod. Pal. Vict., Dec. V. p. 16, pl. XLIV. Figs. 2, 3.

Represented here by an internal cast.

Cudmore Collection.

Fam. VENERIDAE.

Genus **Venus**. Subgenus **Chione**, Megerle.

Venus (Chione) Cainozoicus, T. Woods sp.

Venus (Chione) Cainozoica, T. Woods, 1877, Papers and Proc. R. Soc. Tas. for 1876, p. 113.

Chione Cainozoicus, T. Woods sp., Tate, 1887, Trans. R. Soc. S. Austr. vol. IX. p. 156, pl. XVI. Figs. 3a, b.

Two examples. Cudmore Collection.

Venus (Chione) ? hormophora, Tate, sp.

Chione hormophora, Tate, 1887, Trans. R. Soc. S. Austr., vol. IX., p. 155, pl. XV. Figs. 1a, b.

A cast and also an impressed mould of the shell was found. The former shows the straight ventral region, and the latter the ornamentation, of the above typical Table Cape species.

Cudmore Collection.

Genus **Dosinea**, Scopoli.

Dosinea Johnstoni, Tate.

Dosinea Johnstoni, Tate, 1887, Trans. R. Soc. S. Aust., vol. IX. p. 161, pl. XIV. Figs. 9 and 12.

A mould of a shell of a *Dosinea* in white limestone shows by a wax squeeze the characteristic costation of the above species. The concentric ridges measure 20 in a breadth of 10 mm. and are elevated rather than depressed and rolled over to become almost confluent, as in *D. densilineata*, Pritchard.³ The length of the present example, if complete, would measure about 50 mm. *D. Johnstoni* has a long vertical range, from Balcombian to Kalimnan (Balcombe Bay, Table Cape, Upper Muddy Creek).

Chandler and Cudmore Collections.

3. Proc. Roy. Soc. Vict., Vol. VIII., 1896, p. 135, pl. IV., Figs. 5-7.

Fam. TELLINIDÆ.

Genus *Tellina*, Linné.*Tellina*, aff. *albinelloides*, Tate

Tellina albinelloides, Tate, 1887, Trans. R. Soc. S. Austr., vol. IX, p. 164, pl. XVI. Figs. 4a, b.

A large shell-impression was found here, which agrees in the main characters with the above species. *T. albinelloides* is a Kalimnan form, so that this occurrence, if it be correctly assigned, is unique as a Miocene fossil.

Cudmore Collection.

Tellina, cf. *cainozoica*, T. Woods.

Tellina cainozoica, T. Woods, 1877, Papers and Proc. R. Soc. Tas. for 1876, p. 113. Tate, 1887, Trans. R. Soc. S. Austr., vol. IX., p. 164, pl. XVIII. Fig. 5.

A solitary specimen, doubtfully referred to the above species occurs here.

Cudmore Collection.

Fam. CORBULIDÆ.

Genus *Corbula*, Lamarck.*Corbula pyxidata*.

Corbula pyxidata, Tate, 1887, Trans. R. Soc. S. Austr., vol. IX. 117, pl. XVII. Figs. 12a, b.

A well defined cast in white limestone occurs here

Cudmore Collection.

Corbula ephamilla, Tate.

Corbula ephamilla, Tate, 1887, Trans. R. Soc. S. Austr., vol. IX. p. 176, pl. XVII., Figs. 13a, b, 14.

A mould of this widely distributed species was found here.

Cudmore Collection.

Fam. TEREDINIDÆ.

Genus *Teredo*, Linné.*Teredo directa*, Hutton, sp.

Cladopoda directa, Hutton, 1877, Trans. N.Z. Inst., vol. IX. p. 597, pl. XVI. Fig. 13.

Teredo directa, Hutton, sp., Suter, 1914, Rev. Tert. Moll. N. Zealand, pt. I. (Pal. Bull. 2, N.Z. Geol. Surv.), p. 54.

Two casts of *Teredo* tubes found here correspond with the almost straight small tubes of the above species which came from the Miocene of Canterbury, N. Zealand.

Cudmore Collection.

Class GASTEROPODA.

Fam. TROCHIDAE.

Genus *Astele*, Lwainson.

Astele sp.

Several casts and moulds of a form referable to the above genus occur in the white limestone. It has rather smooth, flat whorls, and a thread-like ornament round the base. It resembles an undescribed species from the Miocene of Victoria.

Cudmore Collection.

Fam. NATICIDAE.

Genus *Natica*, Scopoli.

Natica substolida, Tate, var. *grandis*, nov.

Description.—Shell of the type of *Natica substolida*, Tate,⁴ but of much larger dimensions and heavier build, the length being more than twice that of the specific form (54 mm., as compared with 25 mm. in the species).

A large specimen of *Natica*, somewhat deformed, but evidently belonging to the new variety, has been figured by Mr. C. J. Gabriel and the writer from the Mallee Bores, under the name of *N. subinfundibulum*, var. *crassa*, Tate.⁵

This large variety is fairly common in the limestone of the Ooldea district, and its large size (over 2 inches in length), makes it a conspicuous fossil.

Cudmore Collection.

Natica cf. *hamiltonensis*, Tate.

Natica hamiltonensis, Tate, 1893, Trans. R. Soc. S. Austr., vol. XVIII. pt. 2, p. 319, pl. X. Fig. 6.

A cast referred with slight doubt to this common Tertiary fossil was found here.

Cudmore Collection.

4. *Natica* (*Neverita*) *substolida*, Trans. R. Soc. S. Austr., Vol. XVII., p. II, 1893, p. 323, pl. VI. Fig. 3.

5. Proc. Roy. Soc. Vict., Vol. XXVI. (N.S.) pt. II, 1914, p. 321, pl. XXV., Figs. 15a, b.

Genus **Euspira**, Agassiz.*Euspira* cf. *effusa*, Tate sp.

Ampullina effusa, Tate, 1893, Trans. R. Soc. S. Austr., vol. XVII. pt. 2, p. 327, pl. X. Figs. 2, 2a.

A cast of a globosely whorled naticoid shell was found, of which there is very little doubt as to its relationship. *E. effusa* was recorded by Tate from the Miocene glauconite sands of the Adelaide Bore, whilst Denmant notes it from Brown's and Hamilton Creeks, in Victoria, in beds of Miocene age.

Cudmore Collection.

Fam. CERITHIIDAE.

Genus **Cerithium**, Bruguière.*Cerithium pritchardi*, Harris.

Potamides semicostatum, Tate (non Deshayes), 1885, Papers and Proc. R. Soc. Tas. for 1884, p. 226.

Cerithium pritchardi, Harris, 1897, Cat. Tert. Moll. Australasia (Brit. Mus.) p. 225, pl. VII., Fig. 3.

Numerous pieces of this strongly built shell are included in the collection, some of which had been weathered. They were found accompanied by *Orbicella* in the exposed rubble of the plains. It is a restricted Miocene fossil.

Cudmore Collection.

Genus **Newtoniella**, Cossman.*Newtoniella* sp.

A hollow mould of a shell referable to this genus, and probably new, occurs here.

Cudmore Collection.

Fam. CYPRAEDIAE.

Genus **Cypraea**, Linné.*Cypraea* spp.

These are casts, fairly common, related to the typical forms *C. subsidua*, Tate, and *C. murraviana*, Tate.

Cudmore Collection.

Fam. VOLUTIDAE.

Genus, *Lyria*, Gray.*Lyria acuticostata*, sp. nov.

Description.—Shell long-ovate, volutiform; apically pointed, anteriorly truncated; whorls moderately high, entirely costate, the acute riblets numbering about 18 on the body whorl. Protoconch small, as compared with *L. semiacuticostata*, Prichard,¹ and consisting of two volutions.

The above description is completed from an example in the Dennant collection, from Bird Rock, Torquay, Victoria.

Dimensions.—The limestone specimen measured when complete, circ. 60 mm.; the Torquay marl specimen, 42 mm.

Comparison.—In general shape and acute apex this species is related to *L. semiacuticostata* from Table Cape, but differs essentially in having continuous costation. It is clearly an ancestor of the living *Lyria mitraeformis*,² from which it differs in the more numerous costae and slightly narrower shell.

Cudmore Collection.

Genus *Voluta*, Linné.*Voluta validicostata*, Tate.

Voluta alticostata, Tate, 1889, Trans. R. Soc. S. Austr., vol. XI. p. 122, pl. V. Fig. 7.

Voluta validicostata, Tate (nom. mut.), vide Dennant and Kitson, Cat. Cain. Foss., 1903, p. 100.

Several casts of young and median grown shells are found here. Although occurring in the Balcombian, in Victoria, it is more typical of Janjukian strata, both there and in South Australia.

Cudmore Collection.

Voluta cf. *ancilloides*, Tate.

Voluta ancilloides, Tate, 1889, Trans. R. Soc., S. Austr., vol. XI. p. 126, pl. III., Fig. 7.

A cast of a shell of the above specific type occurs in the hard limestone from Ooldea. *V. ancilloides* is a well-known Table Cape fossil.

Chandler Collection.

Fam. OLIVIDAE.

Genus *Ancilla*, Lamarck.*Ancilla* sp.

A cast of a shell occurs in the limestone, of the type of an *Ancilla* found at Spring Creek and Table Cape (Nat. Mus. Coll.), but of very large dimensions. It must have attained a length of about 50 mm. when complete, whereas the Spring Creek specimens rarely measure more than 20 mm., a difference accounted for by the variation in sedimentation.

Fam. TURRITIDAE.

Genus *Clavatula*, Lamarck.? *Clavatula* sp.

This is an internal cast of the apical portion of a large conical species, with the earlier whorls faintly costate and medially ridged.

Cudmore Collection.

Fam. CONIDAE.

Genus *Conus*, Linné.*Conus* spp.

Probably several species are represented here, but they are all internal casts. So far as can be seen, the commonest form is related to *Conus ligatus*, Tate.⁶

Chandler and Cudmore Collections.

Class CEPHALOPODA.

Fam. NAUTILIDAE.

Genus, *Nautilus*, Linné.*Nautilus* sp. cf. *geelongensis*, Foord.

Nautilus geelongensis, Foord, 1891, Cat. Foss. Cephalopoda (Brit. Mus. pt. II. p. 332, woodcut, Fig. 69. Chapman, 1915, Proc. R. Soc. Vict. vol. XXVII (N.S.), pt. II. p. 354, pl. IV. Figs. 7-9).

The present example is a large specimen (a fragmentary cast), having an approximate diameter of about 6 inches when com-

6. Trans. Roy. Soc. S. Austr., Vol. XIII., pt. 2, 1890, p. 196, pl. VII. Figs. 4, 4a, b; pl. VIII. Fig. 9.

plete. In its broad contour it is nearest to *N. geelongensis*, a Janjukian species from the polyzoal rock generally.

Cudmore Collection.

FOSSIL LISTS.—OOLDEA DISTRICT.

Older Pleistocene.

- | | |
|---|--|
| <i>Orbitolites complanata</i> , Lam. | <i>Turritella clathrata</i> , Kiener. |
| <i>Arca (Anadara) trapezia</i> , Desh. | <i>Bittium cerithium</i> , Q. and G. sp. |
| <i>Pinna incermis</i> , Tate. | <i>Columbella</i> aff. <i>semiconvexa</i> , Lam. |
| <i>Chlamys bifrons</i> , Lam. sp. | sp. |
| <i>Brachyodontes hirsutus</i> , Lam. s.p. | <i>Fusus australis</i> , Q. and G. |
| <i>Marcia (Katelysia) strigosa</i> , Lam. sp. | <i>Fasciolaria australasia</i> , Perry sp. |
| | <i>Mitra pica</i> , Reeve. |
| <i>Clanculus dunkeri</i> , Koch sp. | <i>Bullaria botanica</i> , Hedley. |

Miocene.

- | | |
|---|--|
| <i>Orbitolites complanata</i> , Lam. | <i>Venus (Chione) ?hormophora</i> , |
| <i>Placotrochus deltoideus</i> , Dunc. | Tate. |
| <i>Stylophora</i> , sp. nov. | <i>Dosinea johnstoni</i> , Tate. |
| cf. <i>Montlivaltia</i> , sp. | <i>Tellina</i> aff. <i>albinelloides</i> , Tate. |
| <i>Orbicella tasmaniensis</i> , Dunc. sp. | <i>Tellina</i> cf. <i>cainozoica</i> , T. Woods. |
| | <i>Corbula pyxidata</i> , Tate. |
| ? <i>Laganum</i> sp. | <i>Corbula ephamilla</i> , Tate. |
| <i>Cucullaea corioensis</i> , McCoy. | <i>Teredo directa</i> , Hutton sp. |
| <i>Glycimeris maccoyi</i> , Johnst. sp. | <i>Astele</i> sp. |
| <i>Chlamys murrayanus</i> , Tate, sp. | <i>Natica substolida</i> , Tate, var. |
| <i>Chlamys aldingensis</i> , Tate sp. | <i>grandis</i> , nov. |
| <i>Spondylus</i> cf. <i>gaederopoides</i> , | <i>Natica</i> cf. <i>hamiltonensis</i> , Tate. |
| McCoy. | <i>Euspira</i> cf. <i>effusa</i> , Tate sp. |
| <i>Lima (Limatula) jeffreysiana</i> , | <i>Cerithium pritchardi</i> , Harris. |
| Tate. | <i>Newtoniella</i> sp. |
| <i>Crassatellites</i> cf. <i>oblonga</i> , T. | <i>Cypraea</i> spp. |
| Woods sp. | <i>Lyria acuticostata</i> , sp. nov. |
| <i>Cardita</i> cf. <i>tasmanica</i> , Tate. | <i>Voluta validicostata</i> , Tate. |
| <i>Cardita scabrosa</i> , Tate. | <i>Voluta</i> cf. <i>ancilloides</i> , Tate. |
| <i>Lucina planatella</i> , Tate. | <i>Ancilla</i> sp. |
| <i>Cardium victoriae</i> , Tate. | <i>Clavatula</i> sp. |
| <i>Cardium (Protocardium) antimigranulatum</i> , McCoy. | <i>Conus</i> spp. |
| <i>Venus (Chione) cainozoicus</i> , T. | <i>Nautilus geelongensis</i> , Foord. |
| Woods sp. | |

Episodes in the Formation of the Beds of the Great Bight Area.

In pre-Miocene times the area abutting on the Cretaceous of the Lake Eyre district to the north-west, to Charlotte Waters on the north, to Albany, on the west, and to the Adelaide Plains on the east, and far to the south on what is now the Southern Ocean, was probably dominated by an estuarine or generally base-levelled country. This area also extended through the Riverina as far as Wagga, in New South Wales, and occupied a large part of the Wimmera and Mallee districts of Victoria. The underlying (fundamental) rocks of this area consist mainly of granite,⁷ chloritic slate, felspathic quartzites, slaty rocks and sandstones, all excepting the granite possibly referable either to the Ordovician, Cambrian or metamorphic series, including Algonkian. The deposits laid down on these basal rocks were river, estuarine, swamp and lake accumulations, consisting of sands and clays with carbonaceous and lignitic material.

Following the deposition of these beds, which, by the way, were not uniformly spread over the entire area mentioned, there were occasional oscillations which brought them below sea-level, causing an interstratification of marine beds with the terrestrial. Later, the oscillations ended in a steady to quick downward movement until a depth of at least 100 fathoms below sea-level was reached. In this sea-bed a rich deposit of calcareous mud was formed, filled with debris of polyzoa, echinoids, mollusca and foraminifera. These beds can be referred to the Janjukian series of Victoria, and are homotaxial with the Miocene of Europe.

In Lower Pliocene times (Kalinman series) the sea-bed rose to within a few fathoms of the surface, with fine sandy deposits, upon which flourished molluscs as *Ostrea*, *Natica*, *Turritella* and the sea-urchin, *Laganum*, amongst many other organisms. In places there were huge oyster banks, and in the more rocky parts vast deposits of mollusca peculiar to such conditions, as *Mytilus*, *Barnea*, *Venerupis*, *Arca*, *Cucullaea* and *Glycimeris*, a few species of which facies are still living. Possibly a part of the Miocene limestone of which the fauna is here discussed, may have persisted into the Lower Pliocene, as evidently a few forms, such as *Tellina* cf. *albinelloides* and *Laganum*, seem to indicate.

In the later period of the Pliocene this sea-bed again deepened, and a shell deposit with many existing species was laid down.

⁷ In the Albany district these older limestones (= Plantagenet Beds) have been shown by J. T. Jutson and E. S. Simpson (Journ. and Proc. Roy. Soc. W. Australia, Vol. 11, 1917, p. 48) to have been laid down on the granite.

1



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